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Small-Cell Lung Carcinoma in an 8-Year-Old Boy: A Rare Case Report with Review of Literature

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Abstract

Lung cancer typically affects older adults, with occurrences in children being extremely rare. In adolescents, metastatic lung disease is more common than primary lung cancers. The pathological spectrum of lung cancer in children varies, with small-cell carcinoma being a rare type, accounting for around 4.5% of cases. An 8-year-old boy, previously healthy, presented with moderate-intensity, short-duration chest pain on the left side. Histomorphology, immunohistochemistry characteristics, and fluorescence in situ hybridization confirmed the diagnosis of extensive-stage small-cell lung carcinoma (SCLC). The patient responded positively to six cycles of chemotherapy with etoposide and carboplatin, resulting in the resolution of symptoms. This case underscores the rare instance of SCLC in the pediatric population, emphasizing the diagnostic challenges due to nonspecific symptoms and the necessity for aggressive treatment. It highlights the importance of adapting adult SCLC treatment protocols for pediatric patients to enhance prognosis, given the limited specific guidelines available.

Keywords
- small-cell lung carcinoma
- pediatric
- metastatic lung disease
- histomorphology
- chemotherapy

Introduction

Primary lung neoplasms predominantly occur in late adulthood and old age with occurrence in children being extremely rare.[1] The overall incidence rate is 1 in 2 million, or 0.2% of all pediatric malignancies.[2] Based on the classification by the World Health Organization (WHO), malignant pulmonary tumors of epithelial origin include non-small-cell lung cancer (NSCLC), which is divided into adenocarcinoma, squamous cell carcinoma, and large-cell carcinoma. Additional lung carcinomas include small-cell lung cancer (SCLC) and neuroendocrine tumors.[3]

During childhood, lung and endobronchial cancers make up a very small percentage of all pediatric malignancies.[4] The different types of lung cancer found in children are quite varied, and one of the rarer forms is SCLC, which makes up approximately 4.5% of cases.[5] Only a small number of patients receive a diagnosis at an early stage, while the majority have an advanced-stage disease, which unfortunately has a very grim prognosis, with a survival rate of less than 5% after 2 years.[6–8] Here is the case summary of an 8-year-old boy who received extensive-stage SCLC diagnosis and underwent investigative workup and treatment at our center.

Case Presentation

An 8-year-old school boy from a suburb of Jaipur, Rajasthan, presented to our medical oncology department in July 2023, with complaints of left-sided chest pain of moderate severity and short duration. On admission, he did not exhibit symptoms such as cough, fever, hemoptysis, weight loss, fatigue, or dyspnea. He had no history of smoking or any exposure to passive smoke.

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Upon examination, pallor was noted, but there were no signs of icterus, edema, clubbing, cyanosis, or lymphadenopathy. Auscultation revealed decreased breath sounds in the left lower basal area without any other additional sounds, and the rest of the systemic examination was normal. The results of routine hematological and biochemical tests returned to normal. Chest X-ray revealed a mass on the left lower lung. Contrast-enhanced computed tomography (CECT) scan of the chest revealed a large, well-defined, lobulated, heterogeneously enhancing mass in the left lower lobe, adjacent to the descending aorta and the left posterior aspect of the pericardium, measuring $7 \times 8.5 \times 7.5$ cm. There was minimal left pleural effusion (►**Fig. 1**). Multiple enlarged, heterogeneously enhancing lymph nodes were observed in the left hilar, subcarinal, left retrocrural, and upper paratracheal regions, with the largest measuring 20×20 mm, and a few enlarged lymph nodes in the celiac region.

The positron emission tomography (PET) scan for staging revealed the presence of an irregularly shaped, metabolically active soft tissue mass in the lower left lung lobe. This finding suggests the possibility of primary neoplastic disease (►**Fig. 2**). The mediastinal and left retrocrural regions showed small, inactive lymph nodes, indicating the presence of nearby metastatic lymph nodes. No other abnormal metabolically active lesions were found in the body. A biopsy of the lung mass found a malignant small round cell tumor, suggesting a possible diagnosis of neuroendocrine small-cell carcinoma. Microscopically, the tumor cells were arranged in sheets and occasionally displayed rosette formation. These small, round-to-oval cells exhibited a blue appearance, minimal cytoplasm, inconspicuous nucleoli, and slight overlap with nuclear molding. The stroma was thin and delicate, with occasional mitosis and patchy calcification. Immunohistochemistry (IHC) of the biopsy revealed thyroid transcription factor-1 (TTF-1) and synaptophysin positivity, while CK7 and chromogranin showed focal positivity. The biomarkers CD56, desmin, CD99, vimentin, and NKX 2.2 were found to be negative (►**Fig. 3**). Fluorescence in situ hybridization (FISH) analysis revealed no evidence of EWSR1 gene rearrangement in 100% of the cells studied. Next-generation sequencing did not reveal any clinically relevant pathogenic mutations or fusions.

Based on histomorphology, immunohistochemical features, and FISH reports, a diagnosis of extensive-stage small-cell carcinoma (pure cell type) of the lung was made.

The nature of the disease and the patient's prognosis were explained in detail to the patient's parents, who provided their consent to start chemotherapy. The patient began a chemotherapy regimen consisting of etoposide (100 mg/m^2/dose) and carboplatin (350 mg/m^2/dose) from days 1 to 3, following the latest CHEST recommendations for initial treatment.[9] Chemotherapy led to significant side effects, including intense nausea, vomiting, and neutropenia. He was given oral ondansetron and injectable filgrastim to manage the side effects. During his last follow-up on August 1, 2024, the high-resolution computed tomography of the chest revealed a small atelectatic area adjacent to the pericardium, likely reflecting posttreatment changes (►**Fig. 4**). The patient is currently in remission and continues to be monitored closely.

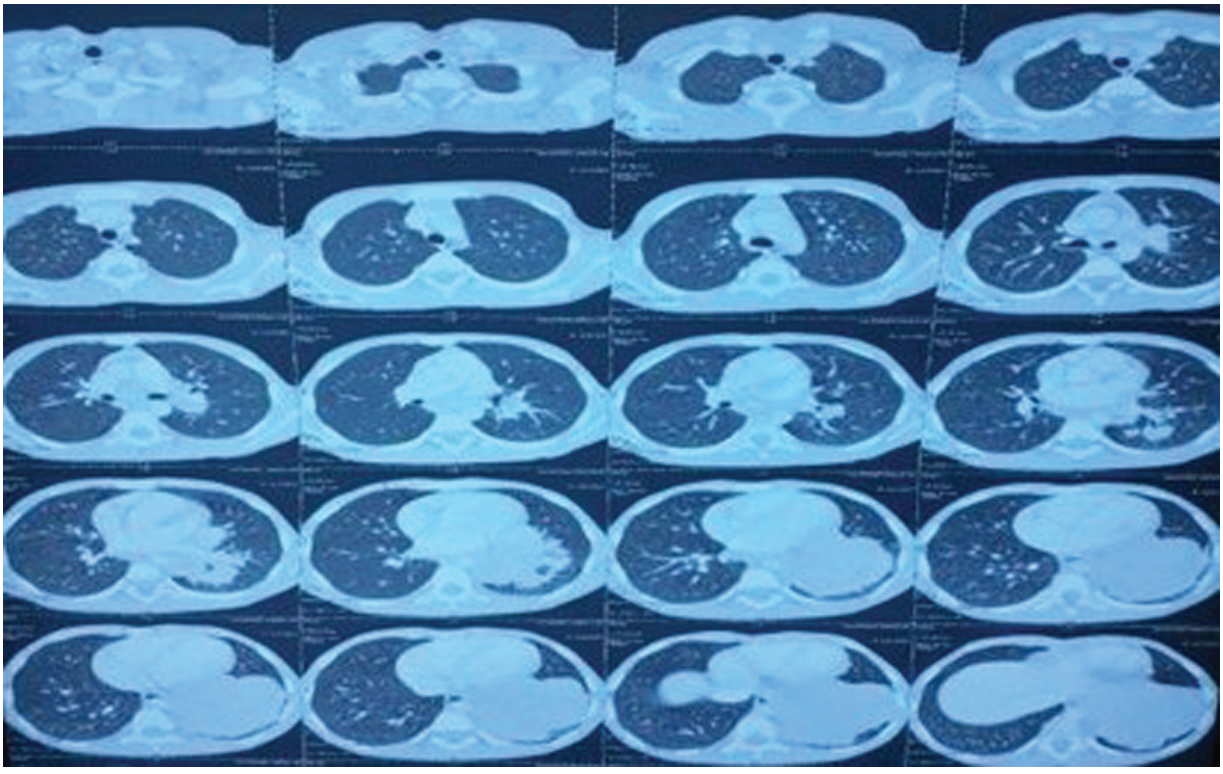

Fig. 1 Contrast-enhanced computed tomography of the chest showing an enlarged mass in the lower left lung.

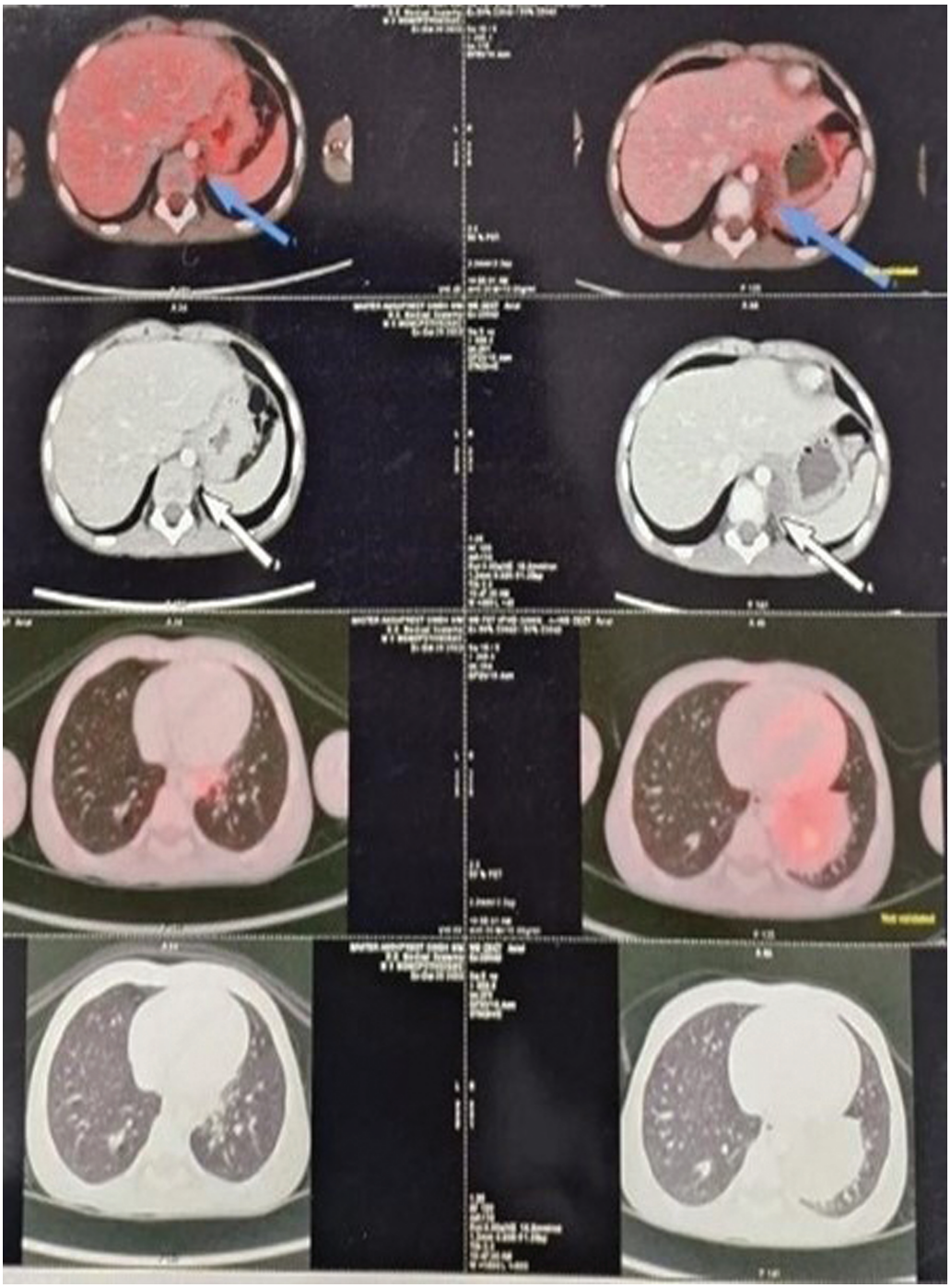

Fig. 2 Positron emission tomography computed tomography scan showing soft tissue mass in the lower left lung lobe.

Discussion

SCLC is predominantly a malignancy seen in middle-aged and older adults, often strongly associated with smoking as a key risk factor. In children, the pathological spectrum of lung cancers is diverse, and SCLC is one of the rarest forms, accounting for only a small fraction of cases.[10] Several reports in the literature highlight that primary malignant pulmonary tumors in children tend to be more aggressive than in adults, often presenting at an advanced stage and with a poor prognosis.[11,12] Delays in diagnosis can occur due to the lack of severe symptoms and low awareness of the disease in pediatric patients. The presenting symptoms are typically nonspecific and may mimic other infectious diseases or congenital lesions.

When considering the differential diagnosis for mediastinal masses, it is important to categorize them based on their location. In the anterior mediastinum, the most common masses include lymphoma, thymoma, teratoma, angioma, lipoma, and thyroid tumors. In the middle mediastinum, vascular anomalies such as double aortic arch, right aortic arch, left aortic arch with aberrant right subclavian artery,

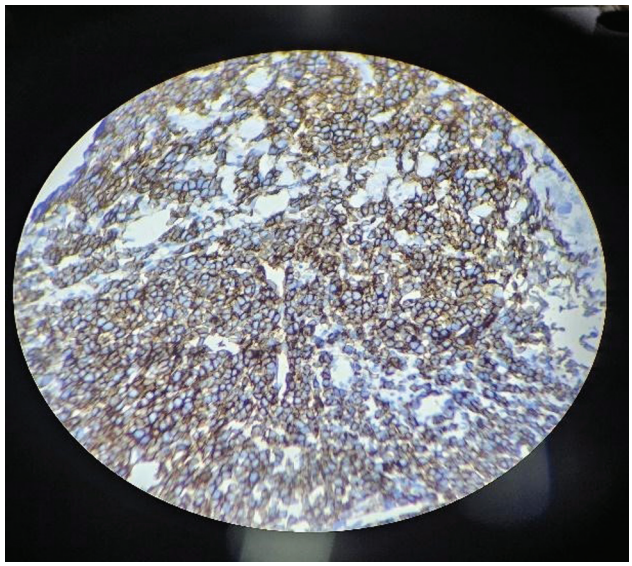

Fig. 3 Immunohistochemistry showing synaptophysin marker positivity.

pulmonary artery sling, and duplicated superior vena cava are often found. Nonvascular middle mediastinal masses can consist of congenital foregut duplication cysts, esophageal duplication cysts, and neuroenteric cysts. Lymphadenopathy can also occur, which may be infectious—typically caused by tuberculosis or histoplasmosis—or neoplastic, as seen in lymphoma, Wilms' tumor, germ cell tumors, and osteosarcoma. In the posterior mediastinum, the most common masses are sympathetic ganglion tumors, such as ganglioneuroblastomas and ganglioneuromas, particularly in older children.[13]

In this case, an 8-year-old boy presented with left-sided chest pain, without typical lung cancer symptoms like cough, shortness of breath, fever, or weight loss complicating the diagnosis given the lack of smoking history. Radiological investigations revealed a large mass in the left lower lung alongside metastatic lymph nodes, prompting further histopathological examination. A biopsy confirmed a malignant small round cell tumor, and FISH analysis ruled out other malignancies, such as Ewing's sarcoma, due to the absence of EWSR1 gene rearrangement.[14]

The treatment of SCLC poses considerable challenges, as only minimal improvements in anticipation have been noted over the past three decades. For adults with early-stage SCLC, surgery may be a viable option aimed at curing the disease. Radiotherapy has diverse effects on both limited-stage and extensive-stage SCLC. The standard initial treatment for SCLC involves antineoplastic therapy, typically combining a platinum-based drug with etoposide or irinotecan.[9]

Given the extensive nature of the disease and the poor prognosis typically associated with SCLC in children, an aggressive treatment approach was adopted. This patient was treated according to the CHEST guidelines with a chemotherapy regimen of etoposide and carboplatin. This treatment plan was selected based on its proven efficacy in adult patients with SCLC and its adaptability to the pediatric population despite the scarcity of specific pediatric treatment protocols for SCLC.

According to existing literature, the youngest reported case of SCLC is in a 14-year-old boy.[15] However, based on our knowledge, the patient in this case report represents the youngest documented case of SCLC to date. The patient's response to chemotherapy was promising, showing considerable improvement, and the patient currently remains asymptomatic. This outcome highlights the potential for effective treatment responses in pediatric SCLC patients, even though these patients are rare and typically have a poor prognosis.

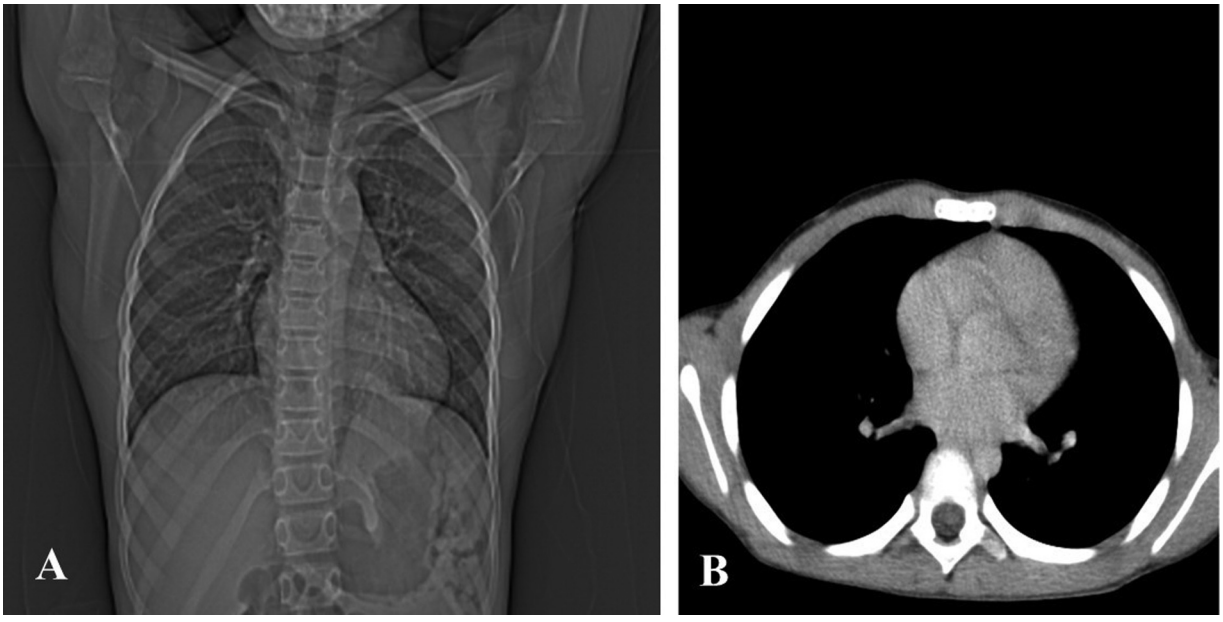

Fig. 4 (**A**, **B**) Posttreatment follow-up chest high-resolution computed tomography images demonstrating a small area of atelectasis in the left lower lobe.

Conclusion

This case emphasizes the importance of early and accurate diagnosis, aggressive treatment, and comprehensive follow-up in managing pediatric SCLC. It also highlights the necessity for further research and development of pediatric-specific treatment protocols to improve outcomes for young patients with this rare and aggressive cancer. The successful management of this case provides hope and valuable insights into the potential for treating similar cases in the future.

Ethics Approval and Consent to Participate

The current study was approved by the institutional review board (IEC/P-835/2024) at the NIMS University, Rajasthan, Jaipur. Written informed consent for publication of this case report and any accompanying images was obtained from the patient's legal guardians.

Patient Consent

Informed consent was provided by the guardian's of the patient.

Authors' Contributions

M.G., S.B., and G.M.B. worked toward managing and following up with the patient. M.G. and R.R. had the inception of the idea of writing the case. S.D. and M.G. wrote the manuscript. G.M.B. edited and fine-tuned the manuscript. S.B. helped in the diagnosis of the disease.

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None.

Conflict of Interest

None declared.

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